

will be caused by lattice misfit between the two layers). In addition, while controlling the lattice spacing in the antiferromagnetic layer, the MR-improving layer is to improve the pinning characteristics of the pinned magnetic layer. Concretely, the MR-improving layer may be any of laminate films or alloy films of Al-Cu, Pt-Cu, Rh-Cu, Pd-Cu, Ir-Cu, Ag-Pt, Ag-Pd, Ag-Au, Au-Pt, Au-Pd, Au-Al, Ru-Rh, Ru-Ir, Ru-Pt, Ru-Cu, or Ag-Au.

As the MR-improving layer suitable to each antiferromagnetic layer, laminate films or alloy films of two elements selected from Cu, Au, Ag, Pt, Rh, Ru, Pd, Al, Ti, Zr and Hf exhibit the subbing effect. When only the pinned magnetic layer is targeted, the MR-improving layer as laminated above the free layer in the bottom type spin valve film illustrated herein could be omitted. For the MR-improving layer that acts as the underlayer for the antiferromagnetic layer herein, the pinned film constitution may have the Synthetic antiferromagnetic structure such as that mentioned above. One example of the SyAF structure employable herein is 5 nanometer Ta/2 nm AuCu/7 nm IrMn/3 nm CoFe/0.9 nm Ru/3 nm CoFe/3 nm Cu/1 nm CoFe/5 nm NiFe/5 nanometer Ta.

In place of the Ta protective film, any of Ti, Zr, Cr, W, Hf, Nb and the like is employable. Those protective films gave the same good results as herein.

Example e:

In this Example e, produced was a bottom type spin valve film of 5 nanometer Ta/2 nm AuCu/7 nm IrMn/2.5 nm CoFe/2.5 nm AuCu/4 nm CoFe/2 m AuCu/5 nanometer Ta, in the same manner as in Example a. In this, the AuCu layer disposed between the lower CoFe layer (pinned magnetic layer) and the upper CoFe layer (free layer) is a nonmagnetic spacer layer acting also as an MR-improving layer for magnetostriction control in the free layer.

In bottom type spin valve films, the fcc-d(111) spacing in the free layer as formed in the nonmagnetic spacer layer of Cu or the like is narrow and therefore the magnetostriction in the free layer is enlarged. However, in the film of this Example e in which the free layer of CoFe is laminated on the AuCu alloy layer acting as a nonmagnetic spacer layer and also as an MR-improving layer, the fcc-d(111) spacing in the free layer of CoFe is controlled on a suitable level whereby the magnetostriction in the free layer could be reduced.

The spin-dependent scattering on the interface between the nonmagnetic spacer layer of AuCu and the CoFe layer is attenuated in some degree, as compared with that on the interface between AuCu and a single-layered Cu, whereby the MR ratio in the film will decrease in some degree. This problem could be solved, for example, by using a laminate film of 0.8 nm Cu/0.8 nm AuCu/0.8 nm Cu as the nonmagnetic spacer layer.

The nonmagnetic spacer layer acting also as an MR-

improving layer is effective not only in the bottom type spin valve film as herein but also in ordinary spin valve films and in dual element-type spin valve films. One example of dual element-type spin valve films incorporating such a nonmagnetic spacer layer that acts also as an MR-improving layer is 5 nanometer Ta/2 nm AuCu/7 nm IrMn/2.5 nm CoFe as pinned magnetic layer/2.5 nm AuCu as nonmagnetic spacer layer and also as MR-improving layer/3 nm CoFe as free layer/2.5 nm Cu/2.5 nm CoFe as pinned magnetic layer/7 nm IrMn/5 nanometer Ta. One example of ordinary spin valve films incorporating such a nonmagnetic layer that acts also as an MR-improving layer is 5 nanometer Ta/2 nm AuCu/4 nm CoFe/0.8 nm Cu/0.8 nm AuCu/0.8 nm Cu/2.5 nm CoFe/7 nm IrMn/5 nanometer Ta.

In bottom type spin valve films and dual element-type spin valve films, where the fcc-d(111) spacing in the free layer of CoFe is well controlled by the effect of the AuCu layer which is used as the underlayer for the antiferromagnetic layer of IrMn or the like, any ordinary Cu layer or the like may be used as the nonmagnetic spacer layer.

The following are other examples of bottom type spin valve films and dual element-type spin valve films:

5 nanometer Ta/1 nm Au/1 nm Cu/7 nm IrMn/2.5 nm CoFe/0.9 nm Ru/3 nm CoFe/3 nm Cu/4 nm CoFe/5 nanometer Ta,
 5 nanometer Ta/1 nm Au/1 nm Cu/7 nm IrMn/2.5 nm CoFe/3 nm Cu/4 nm CoFe/5 nanometer Ta,